Reproductive System

Reproduction is the key to the continuation of life and the major driving force in the lives of most organisms.

Two basic methods of reproduction

Asexual

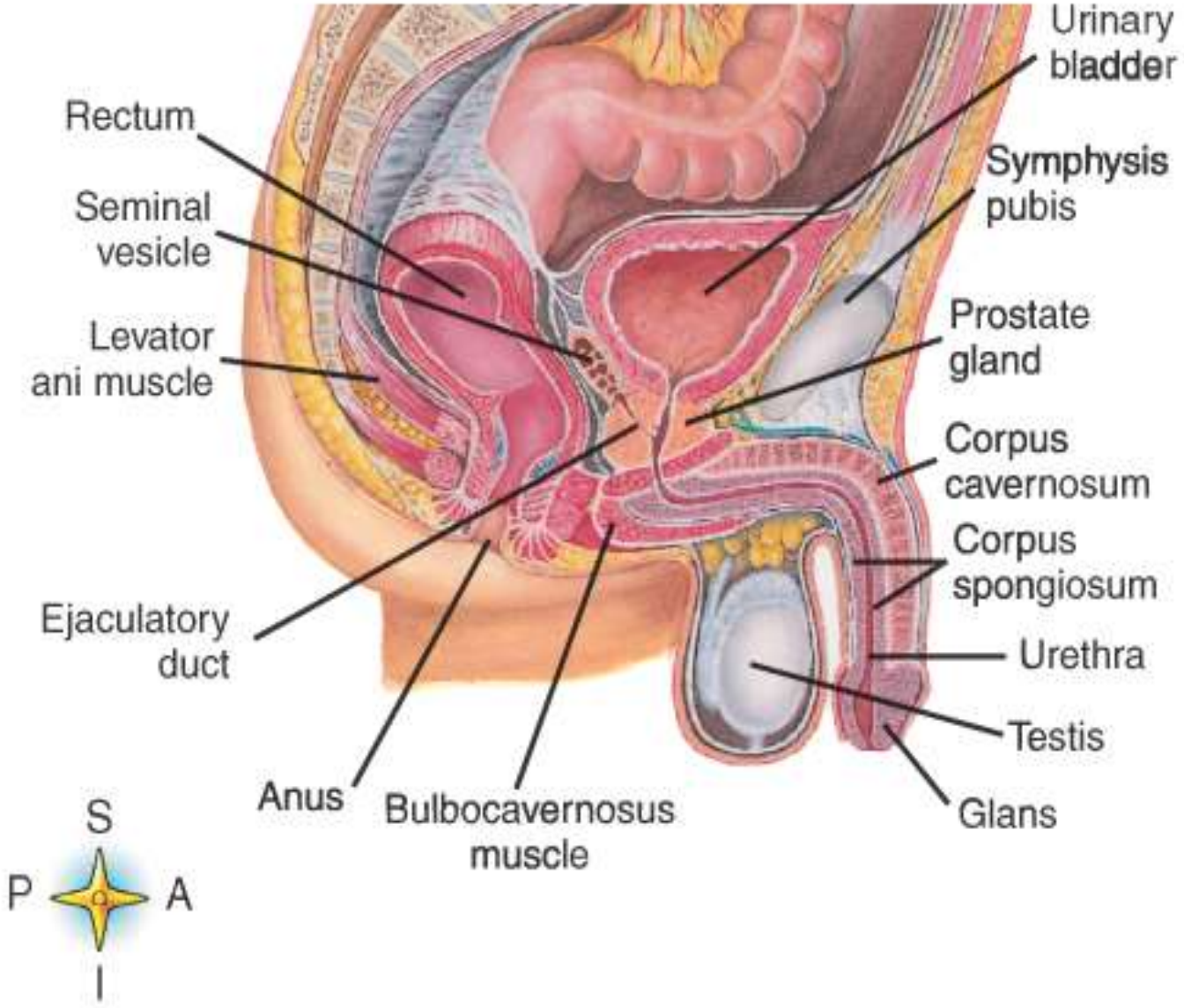
- **reproducing with one parent organism – no mixing of genetic materials**
- **Advantages: quick and easy; no need to find or convince a partner**
- **Disadvantage – no genetic variability**

Sexual

- **the union of haploid gametes to form a diploid zygote**
- **Advantage – genetic variability which allows adaptation and evolution**

- Disadvantages – wastes energy in the production of lots of pollen/sperm/eggs; chance meetings; takes time and energy to find a mate; vulnerability during mating

Male Reproductive System



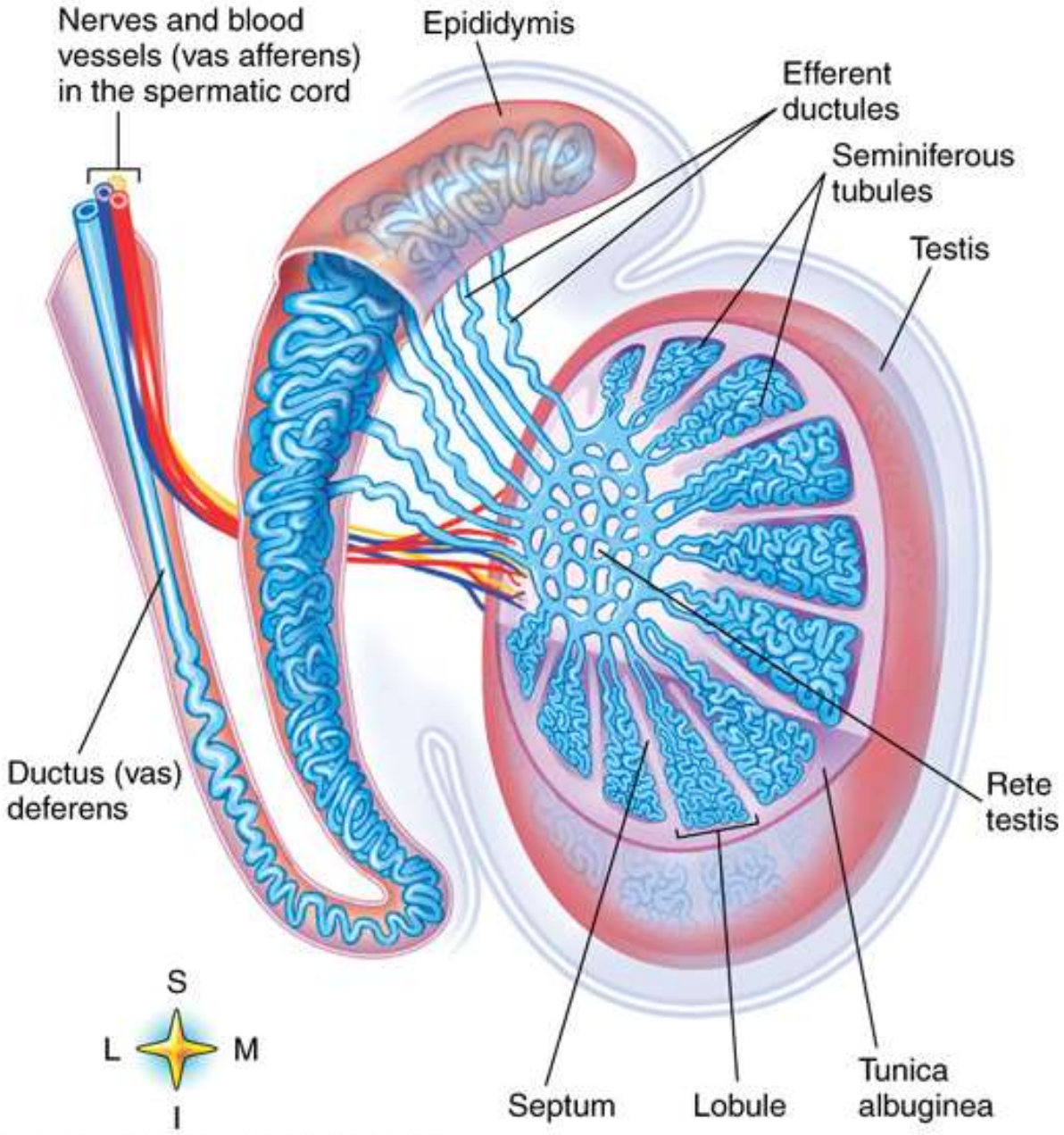
Male Reproductive System

Structure and Function

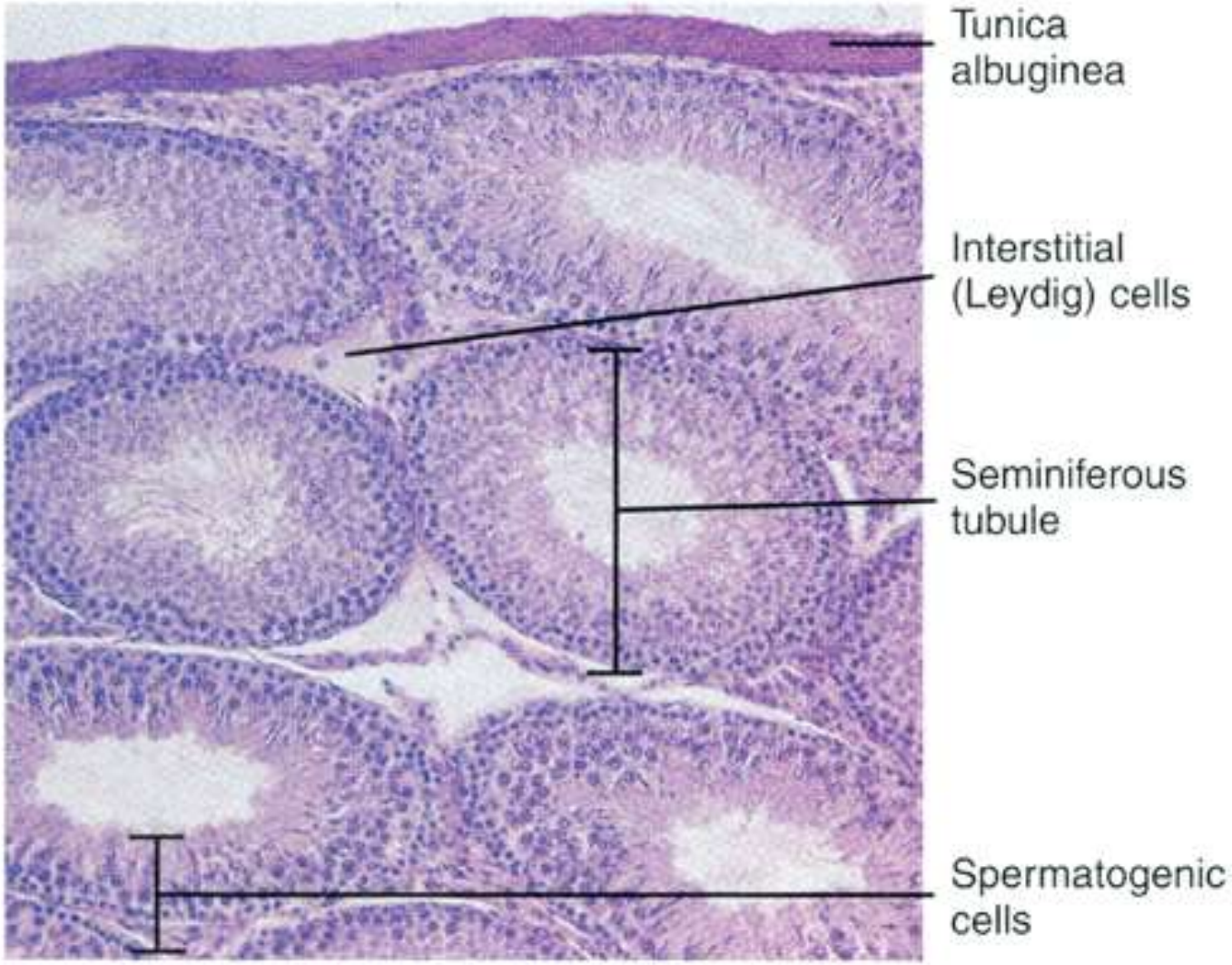
1. **Testes = male gonads**

- **paired, ovoid gamete-producing organs found suspended by the spermatic cords from the body and enclosed in the scrotum at maturity**
- **Descend from the abdomen before birth**
  - **Inguinal hernia**
- **Also produce male androgens (testosterone) which trigger the development of secondary sex characteristics at puberty**

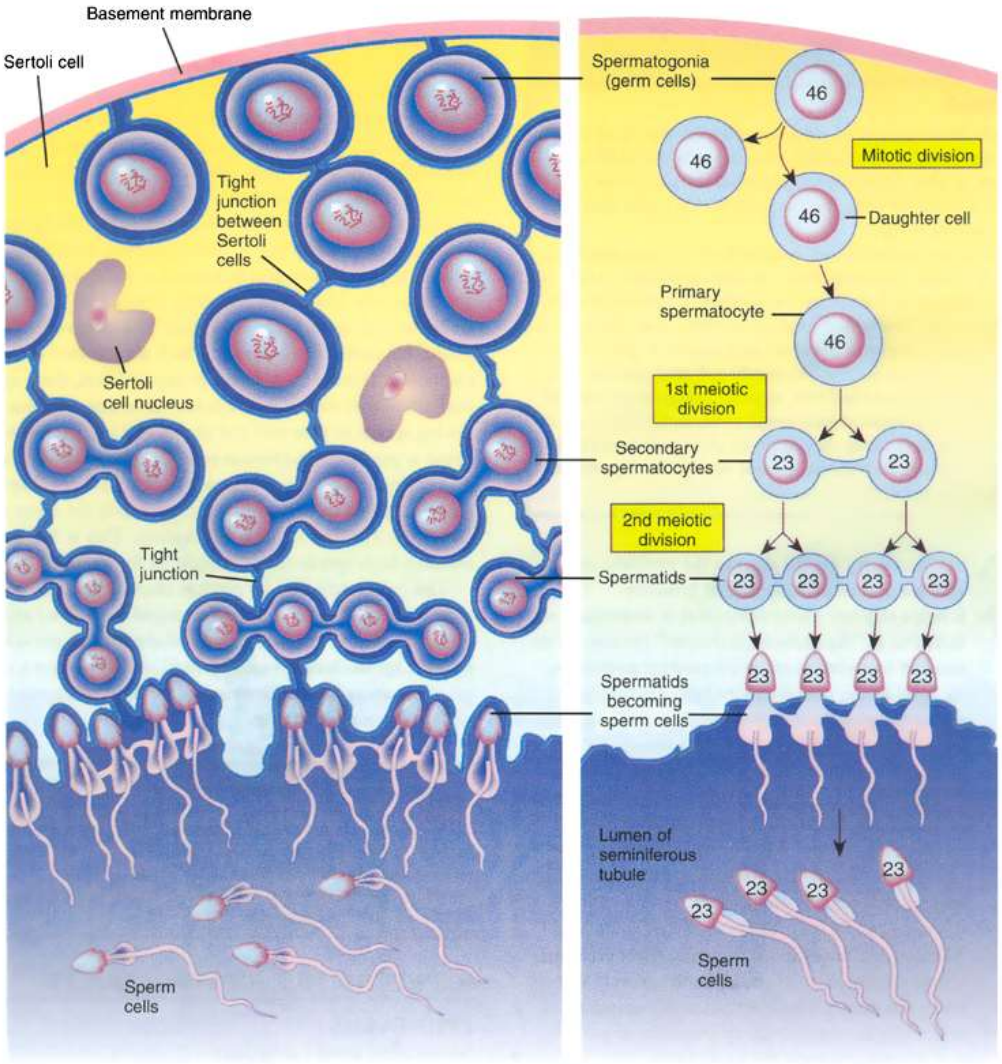
Structure of Testes



Cross section of testes



Spermatogenesis



A) Formation of sperm

- **spermatogenesis takes place in the seminiferous tubules**
- **meiotic division that results in genetically unique haploid sperm cells**
- **lined with epithelium consisting of spermatogenic cells and sertoli (nurse) cells**
- **mature spermatozoa lie on the inner surface of tubule with heads imbedded in sertoli cells which support and maintain them**
- **upon maturation, sperm are discharged to the lumen where they pass to the epididymis**
- **millions produced daily from puberty until death**

B) Scrotum

- cutaneous sac-like structure containing testes
- outside of body so temperature is cooler for correct sperm production (2 degrees C cooler)

2. Ducts = system for conveying sperm to outside of body

A) epididymis

- found along borders of each testis
- highly coiled (6-7 m.)
- lined with pseudostratified epithelium
- smooth muscle in walls
- sperm become mobile here

B) Vas deferens

- pass upward in spermatic cord from epididymis to urethra

C) Urethra

- passes sperm to outside of body
- secretions from glands added to sperm to form semen
- also carries urine

3. Seminal Vesicles

- two lobed, membranous pouches that produce a thick sticky fluid which is added to the sperm

- **contains prostaglandins which stimulate muscle contractions of the tubules; fructose which provides energy for the sperm mitochondria; and proteinaceous substances for semen coagulation**

4. Prostate Gland

- surrounds urethra near the bladder

- produces an alkaline fluid with citric acid, zinc, mangesium, and enzymes

5. Bulbourethral Glands (Cowper's Gland)

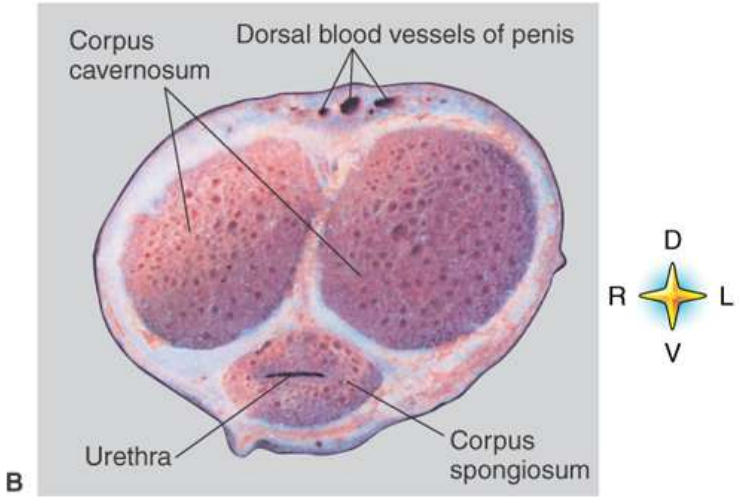
- two pea-sized glands alongside the urethra

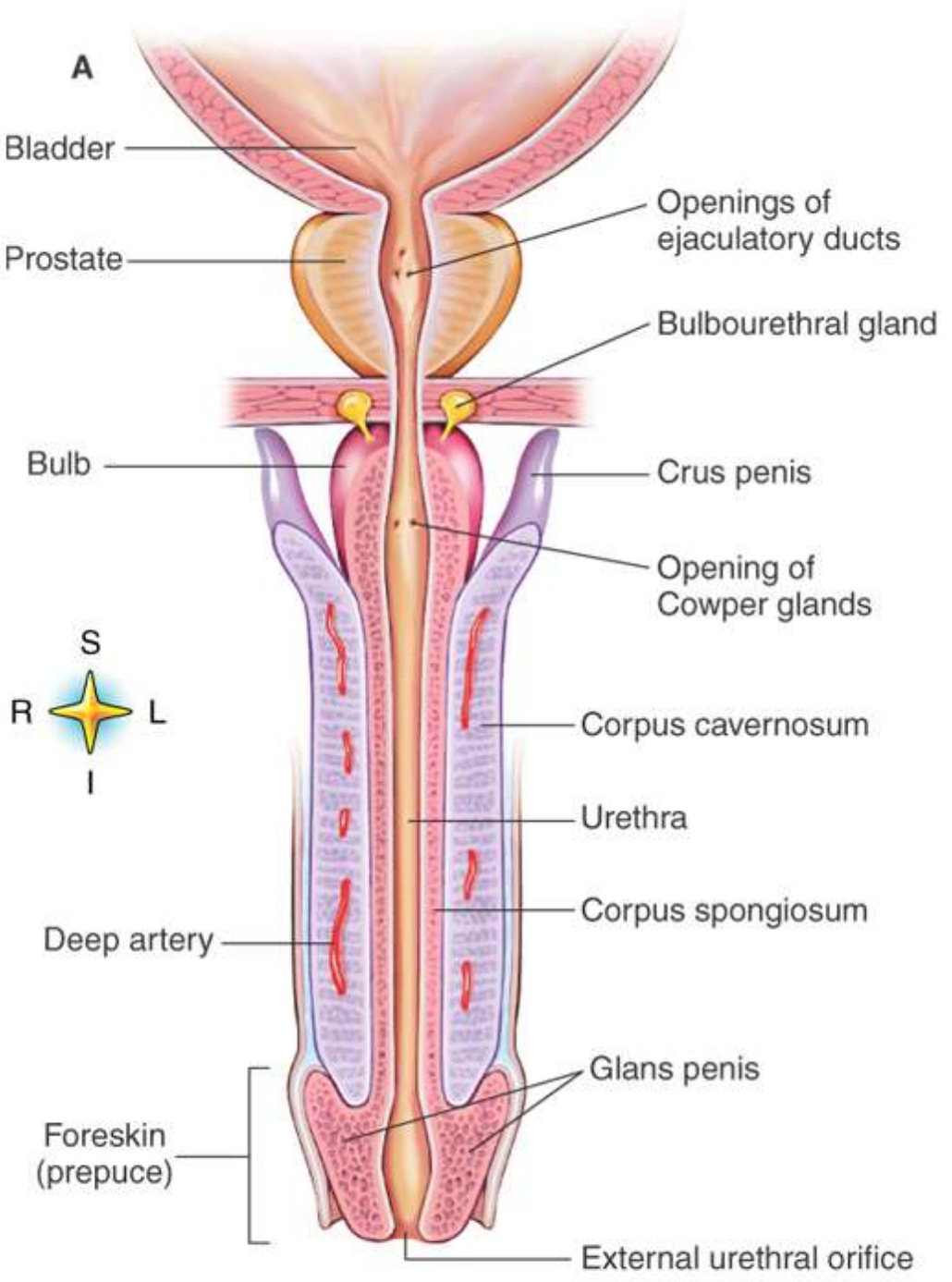
- secrete a clear, viscous, mucus-like substance which serves as a lubricant

6. Penis

- intromittent/copulatory organ for the transfer of sperm to the female
- spongy cylinders – 3 masses of erectile tissue w/ large blood spaces that become engorged w/ blood, bringing about the erection of the penis
- 2 corpus cavernosa on each side running parallel and 1 corpus spongiosum enclosing and below the urethra
- glans = distal end of the penis
    - urethral orifice/meatus at the end
    - high concentration of nerve cells
- erection – reflex act by vasodilation of arteries supplying erectile tissues with blood
    - vein constriction prevents outflow of blood

Structure of the Penis



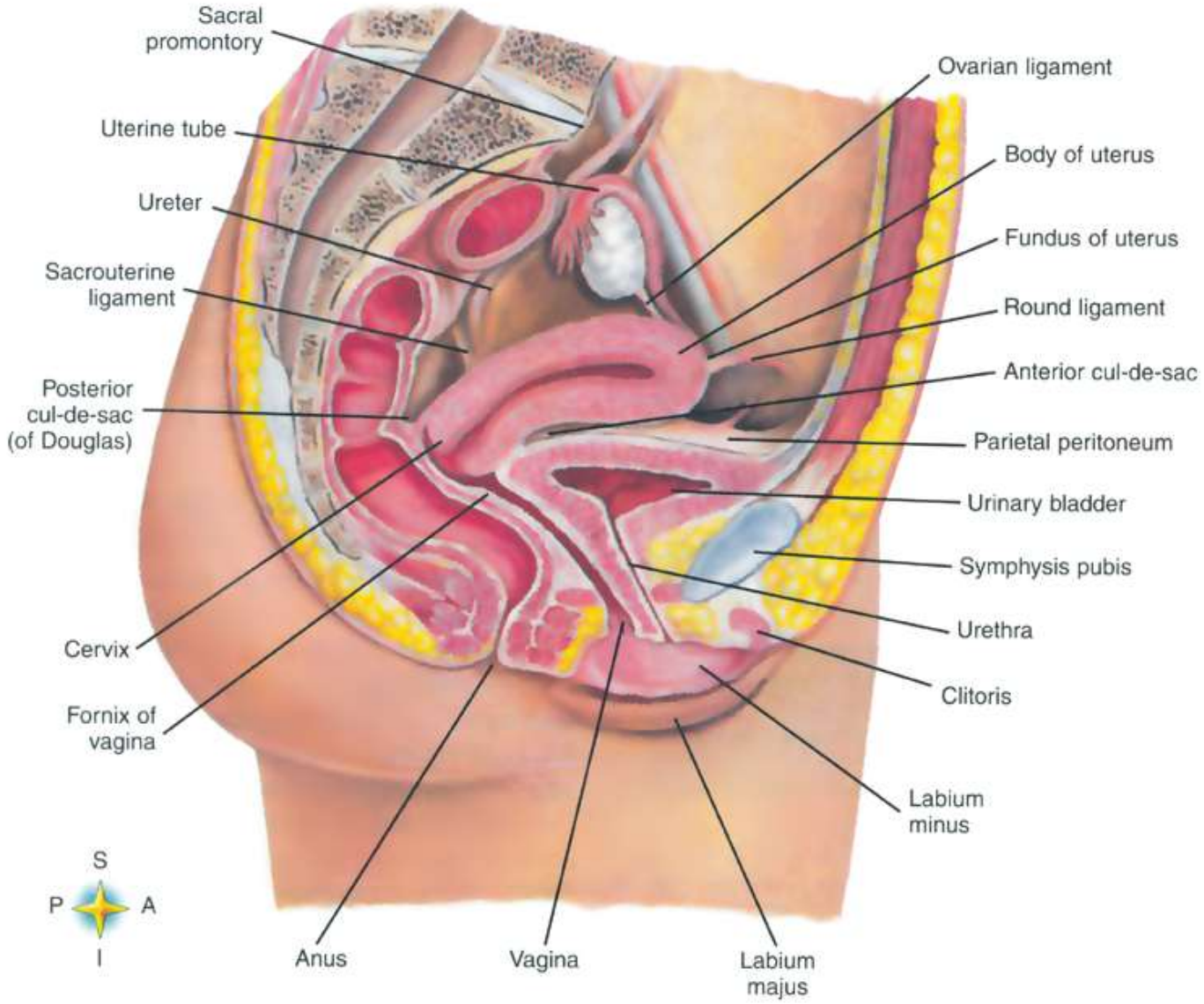


- ejaculation – passage of seminal fluid (semen) during sexual intercourse/coitus
  - caused by contractions of muscles in the seminal vesicles and vas deferens
  - average contains 200 – 400 million sperm
  - retain mobility for several days, though the ability to fertilize the egg is limited to about 24 hours

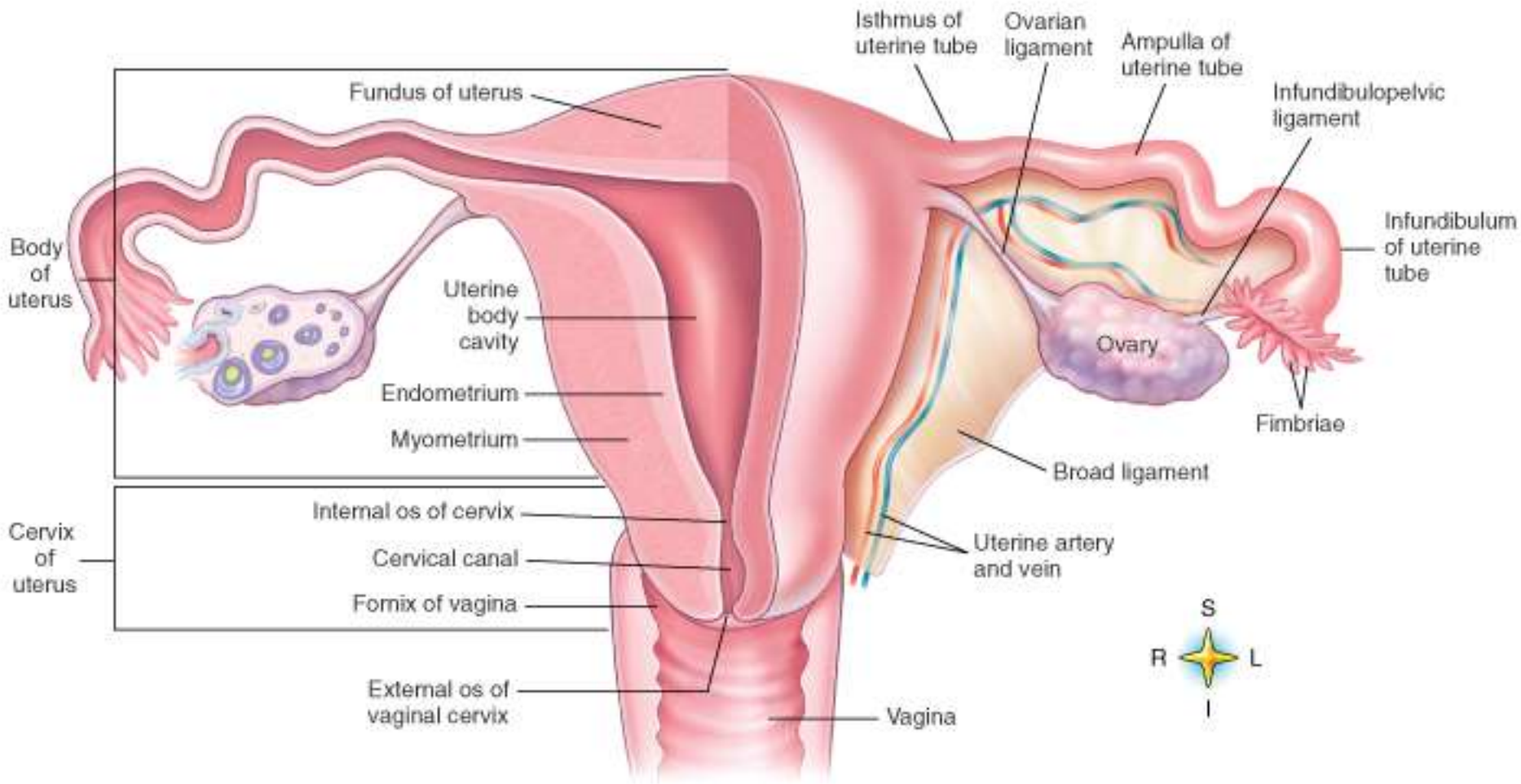
Sperm cell = Spermatazoa

- oval head with nuclear portion containing genetic material and acrosome (enzymatic region)
- Middle body region has a sheath of mitochondria around an axial filament which extends to the tip of the tail
- Determines the sex of the offspring

Female Reproductive System



Female Reproductive System



Structure and Function

1. **Ovaries = female gonads**

   - paired oval structures lying close to the lateral walls of the pelvic cavity

   - source of female gametes (ova) and females hormones

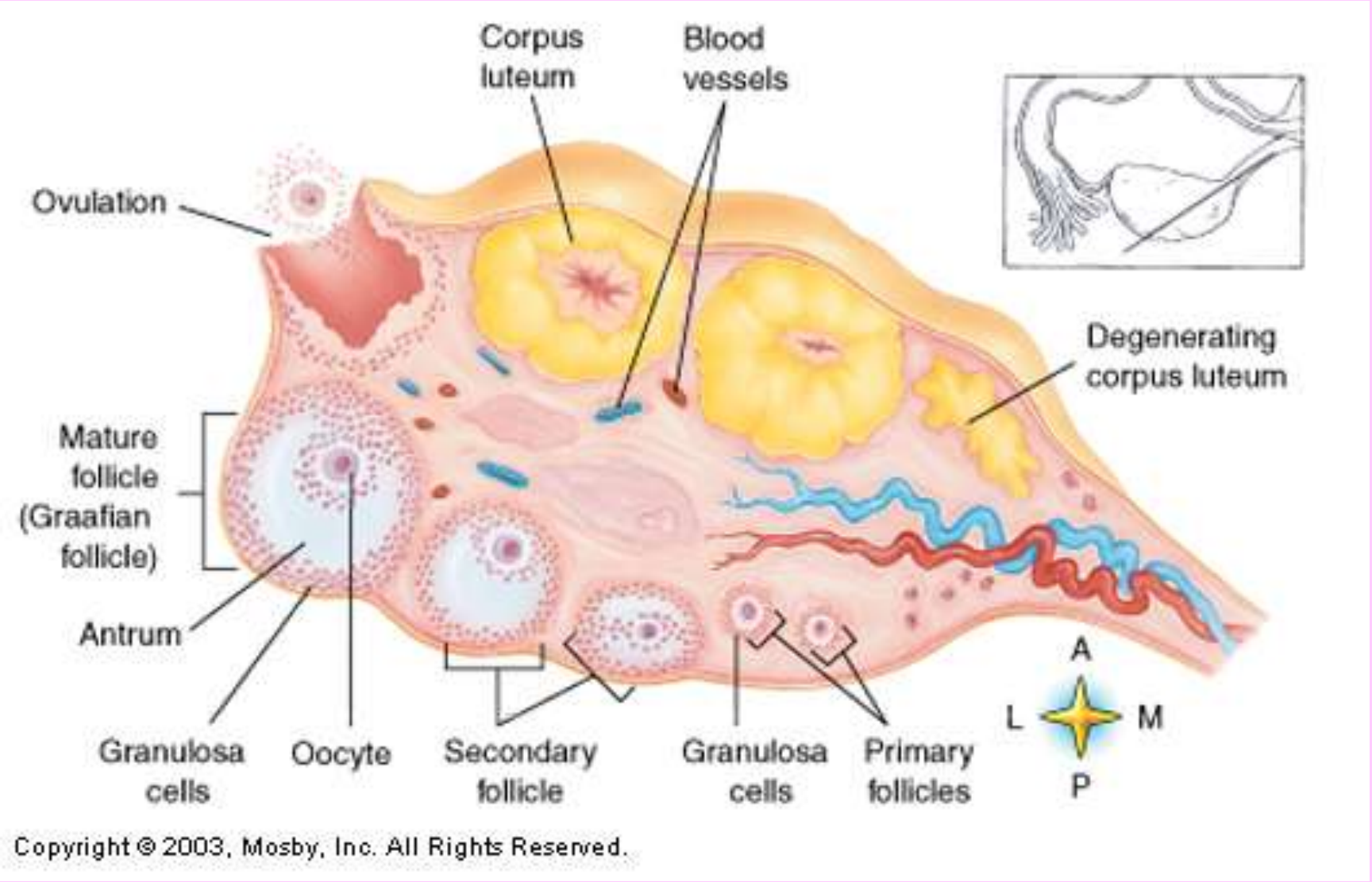
   - follicles (containing ova) at various stages of development (primary, growing, mature) are found in the cortex

   - medulla is the inner layer composed of loose connective tissue w/ blood vessels, lymphatic vessels, some smooth muscle fibers, and interstitial cells

   - females are born w/ all of the eggs they will ever have

      - stay at an early stage of division until stimulated to develop by hormones

- follicle = an ovum (oocyte) surrounded by layers of follicle cells (about 200,000 in each ovary)



2. Oviducts = Fallopian Tubes

- **tubes which carry the ovum to the uterus**
- **approx. 12 cm. Long with proximal end open to the uterus and distal end having an expanded fringed border (fimbriae) next to the ovary**
- **walls of ciliated columnar epithelium**
- **cilia beat in unison to create a current which carries the ovum to the uterus**
- **peristaltic contraction also help move the ovum**

3. Uterus

- **highly elastic organ whose main function is to contain the developing embryo**
  - **simplex shape in humans**
  - **bipartite in cat**

- muscular, pear-shaped, lies in the pelvic cavity between bladder and rectum

- Layers:
  - endometrium (mucosa) – single layer of simple columnar epithelium on connective tissue with some ciliated cells
  - myometrium (muscular layer) – major portion; bundles of smooth muscle cells in layers (longitudinal, circular, longitudinal)
    - elastic fibers abundant
  - perimetrium (serosa) – outermost layer of fibroelastic tissue
- Cervix – external opening of the uterus
  - largest, most powerful sphincter muscle in female

- protrudes into the upper end of the vagina

4. Vagina

- highly elastic canal which receives the penis during coitus
- also serves as the birth canal
- layers:
  - mucosa – lined with stratified squamous epithelium. Highly vascularized. Moistened by mucous secretions of the uterine glands.
  - muscular coat – bundles of smooth muscle at the external orifice
  - fibrous coat – thin layer of connective tissue merging with tissues of surrounding structures

5. External Genitalia (vulva)

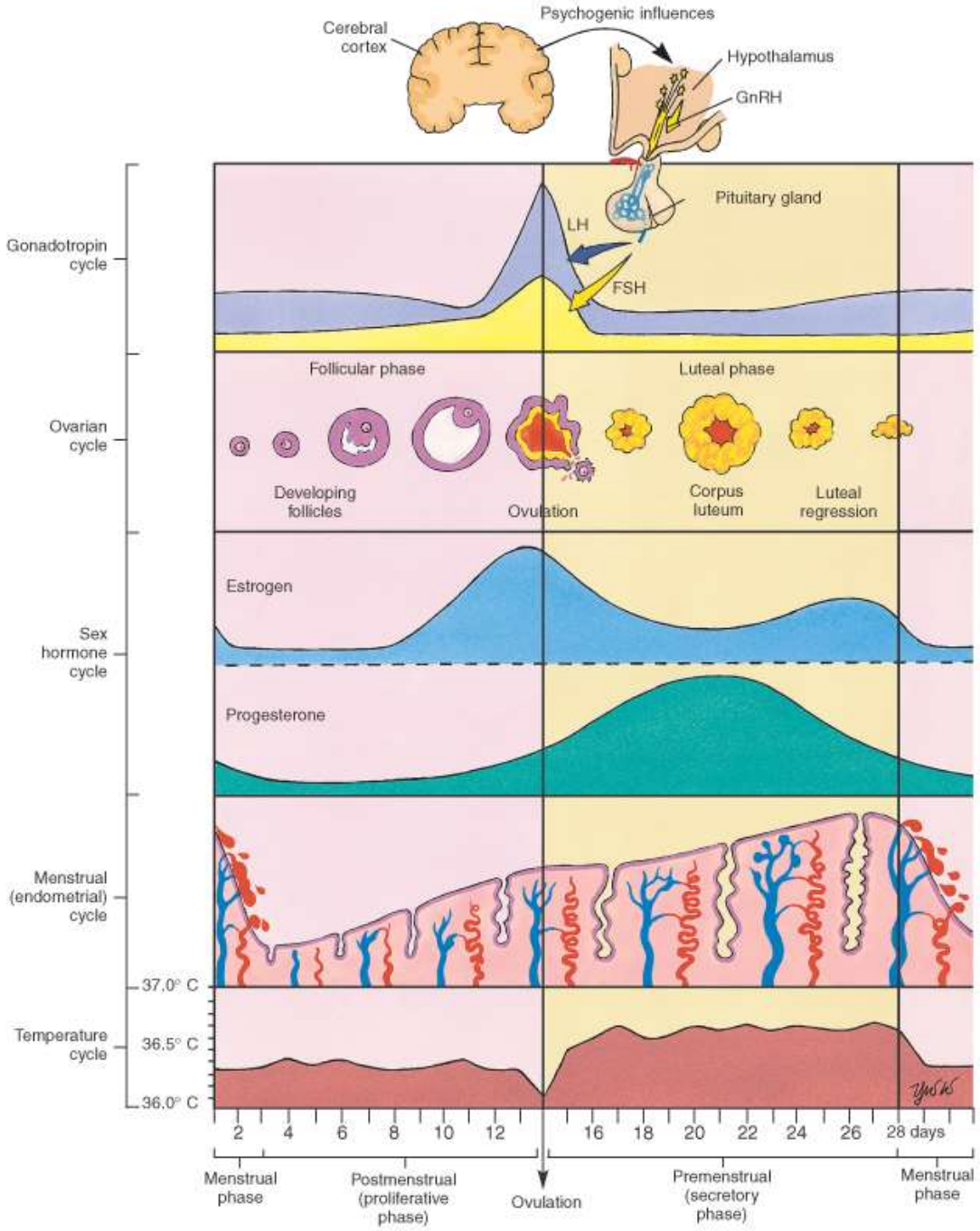
- **clitoris – small erectile structure lying beneath the pubic symphysis at the juncture of the labia minora**
  - **contains many sensory neurons**
- **labia majora – two prominent longitudinal folds of skin which form the lateral walls of the vulva**
- **labia minora – two small longitudinal folds which lie just within the labia majora forming the lateral folds of the vestibule**
- **urinary meatus – opening of the urethra into the vestibule**
- **vaginal orifice – opening to the vagina**

Menstrual Cycle = Uterine & Ovarian Cycles

- occurs in non-pregnant women from puberty (12-14 yrs) until menopause (45-55 yrs)
- cyclic changes that occur on the average every 28 days (range 21 to 35 days) to the endometrium correlating with cyclic changes in the ovaries as regulated by female hormones

Stages:

1. **Menstruation**
   - discharge of blood and endometrial tissue from the vagina
   - lasts approximately 3 days
   - ends as a new follicle develops in the ovaries



2. Proliferative stage – Follicular

- follicle matures in the ovary and secretes estrogen
- estrogen stimulates the restoration and thickening of the endometrium in preparation for receiving a fertilized egg
- days 4 – 14

3. Ovulation

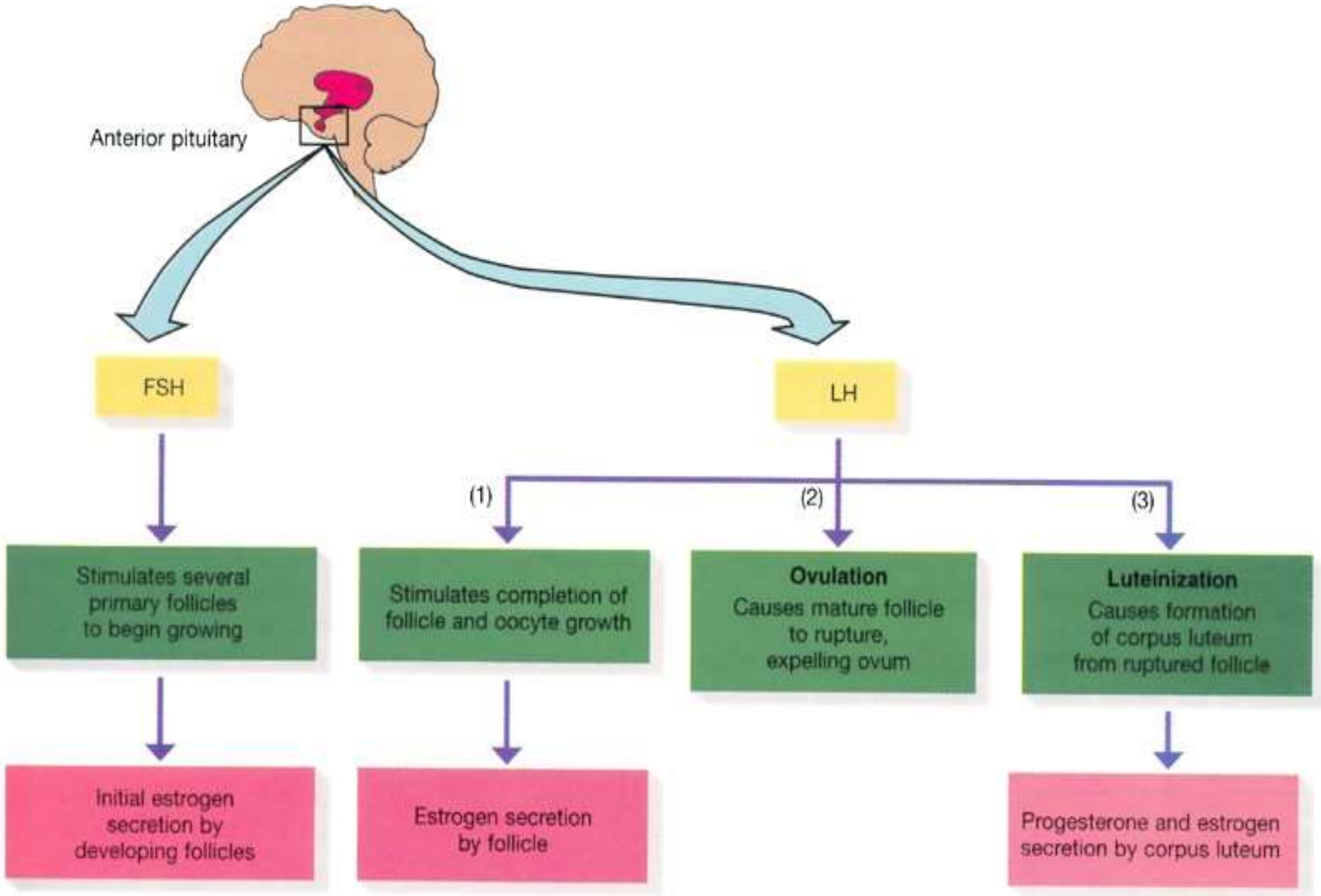
- release of a mature egg from the ovary
- normally on day 14

4. Secretory Stage (premenstrual or luteal phase)

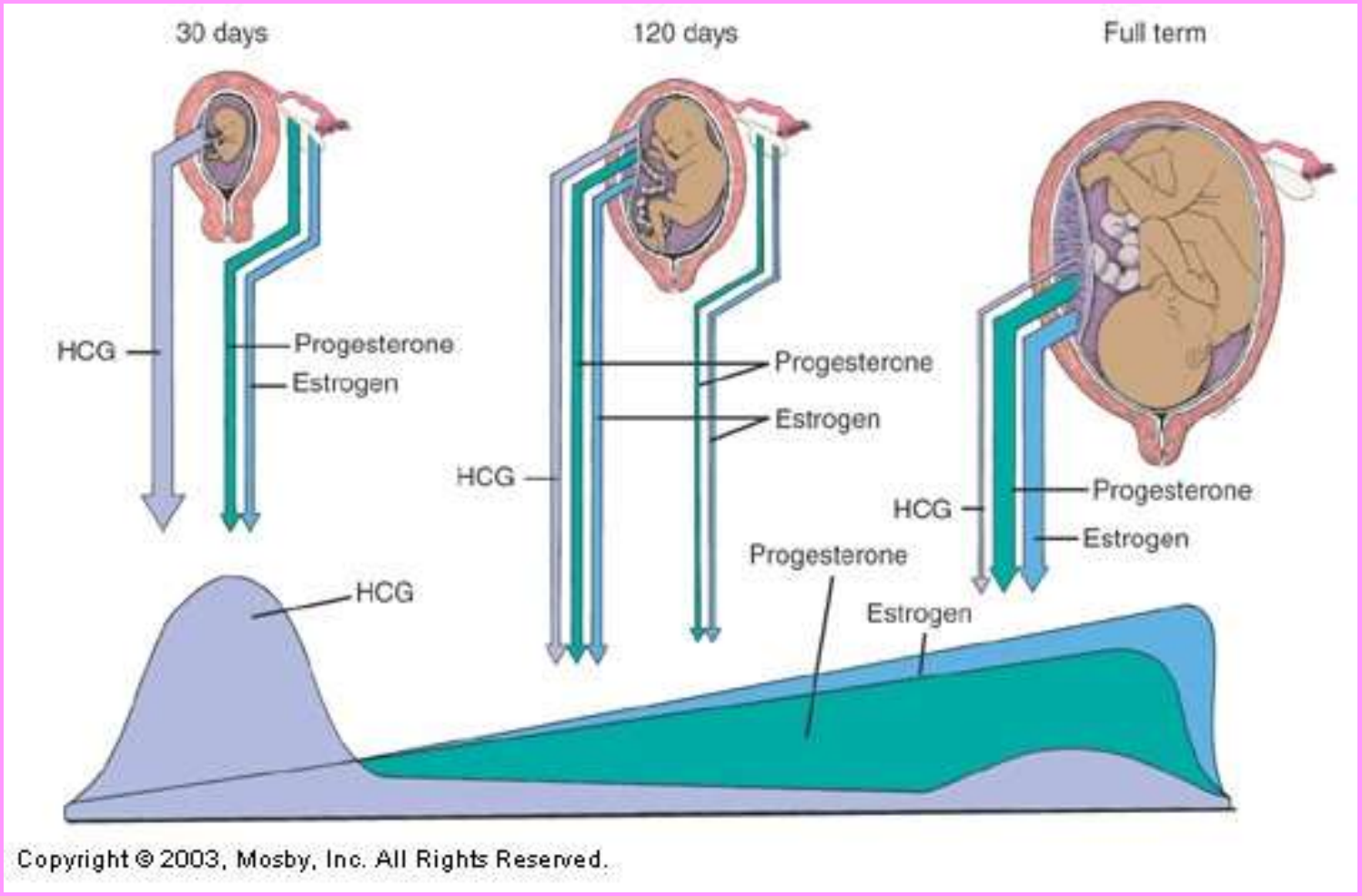
- ruptured follicle develops into the corpus luteum which releases progesterone
- progesterone causes the endometrium to thicken further

- days 15 – 28
- if fertilization is not achieved, corpus luteum regresses, progesterone level decreases and endometrium sloughs off along with unfertilized egg (menses)

Pituitary Gland produces luteinizing hormone (LH) and follicle stimulating hormone (FSH) which maintain the follicle and corpus luteum



If pregnancy occurs the chorion surrounding the fetus becomes an endocrine gland and produces Human Chorionic Gonadotropin which helps maintain the endometrium

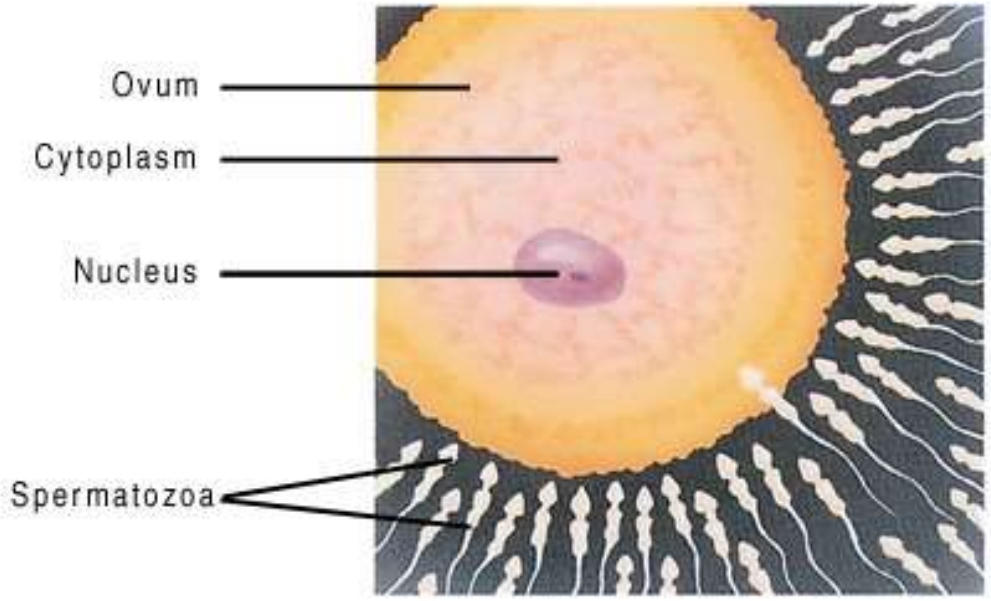


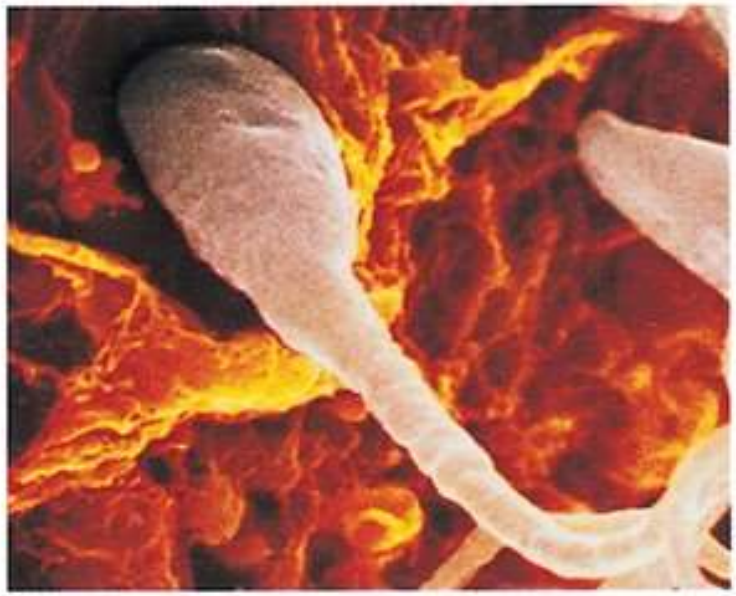
Fertilization and Development

Fertilization – union of haploid gametes – sperm and egg

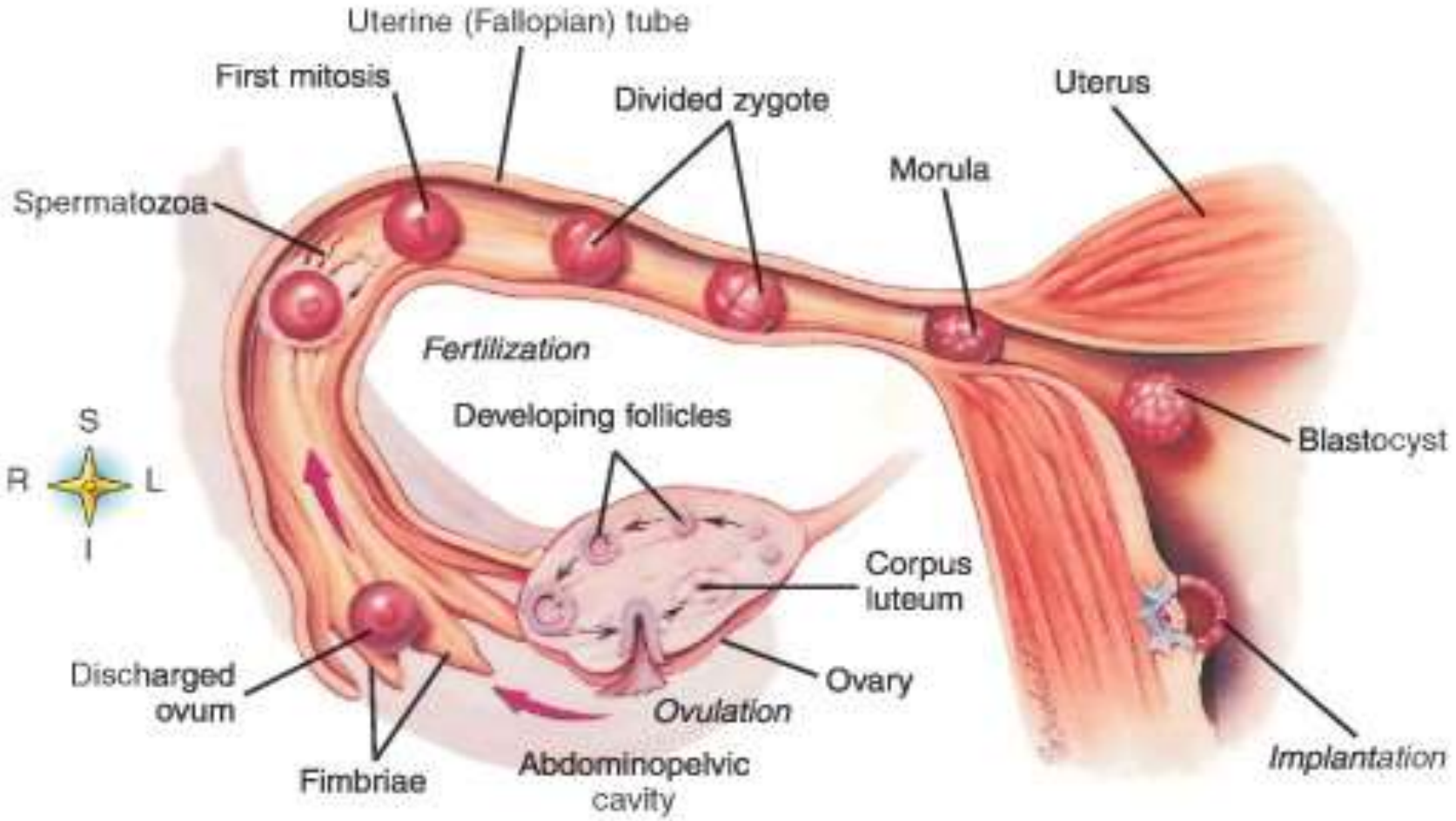
Acrosome of sperm dissolves a passageway through the cell membrane into the egg.

- sperm nucleus passes into the egg and unites with egg nucleus



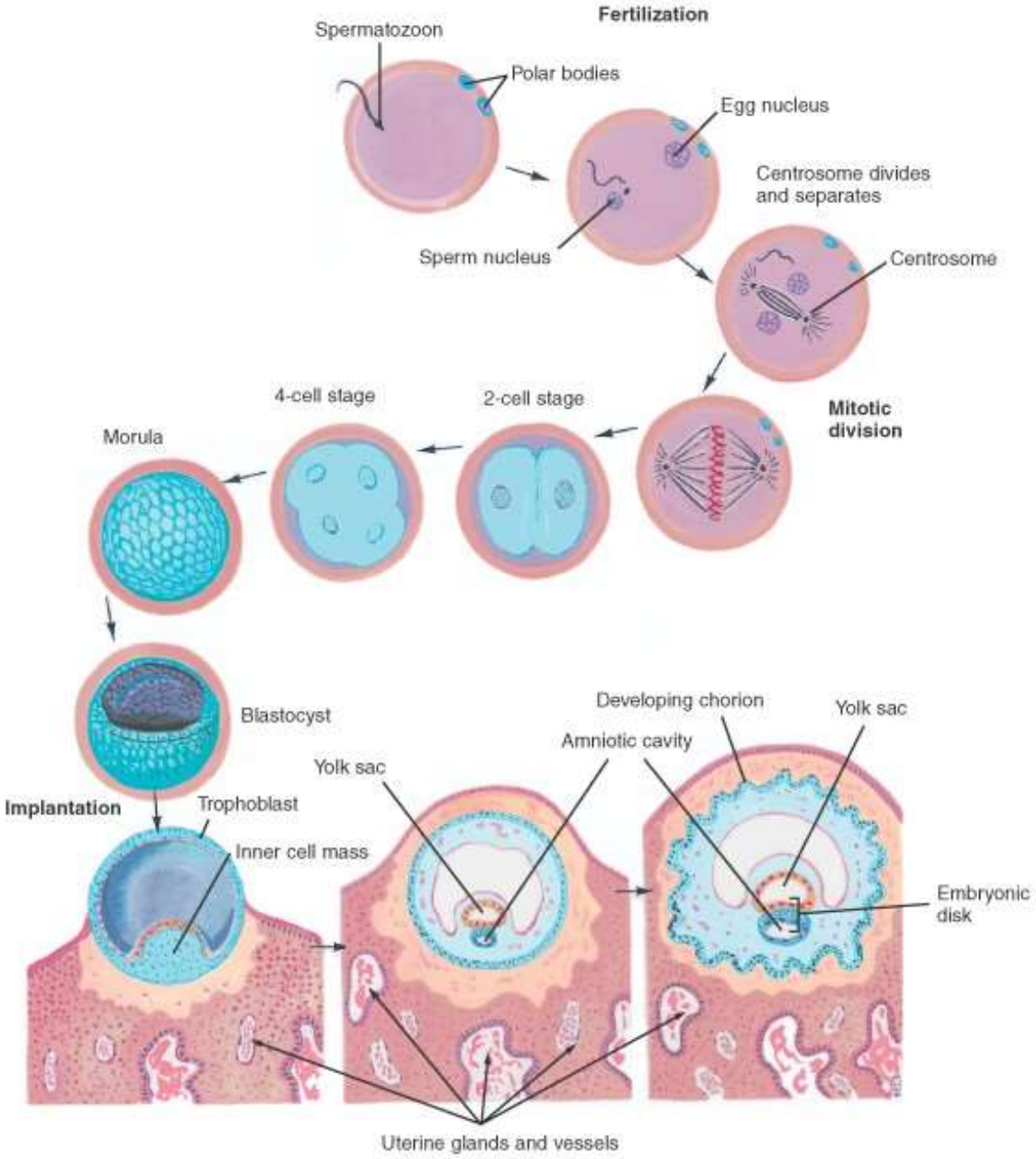


Fetilization and Early Development

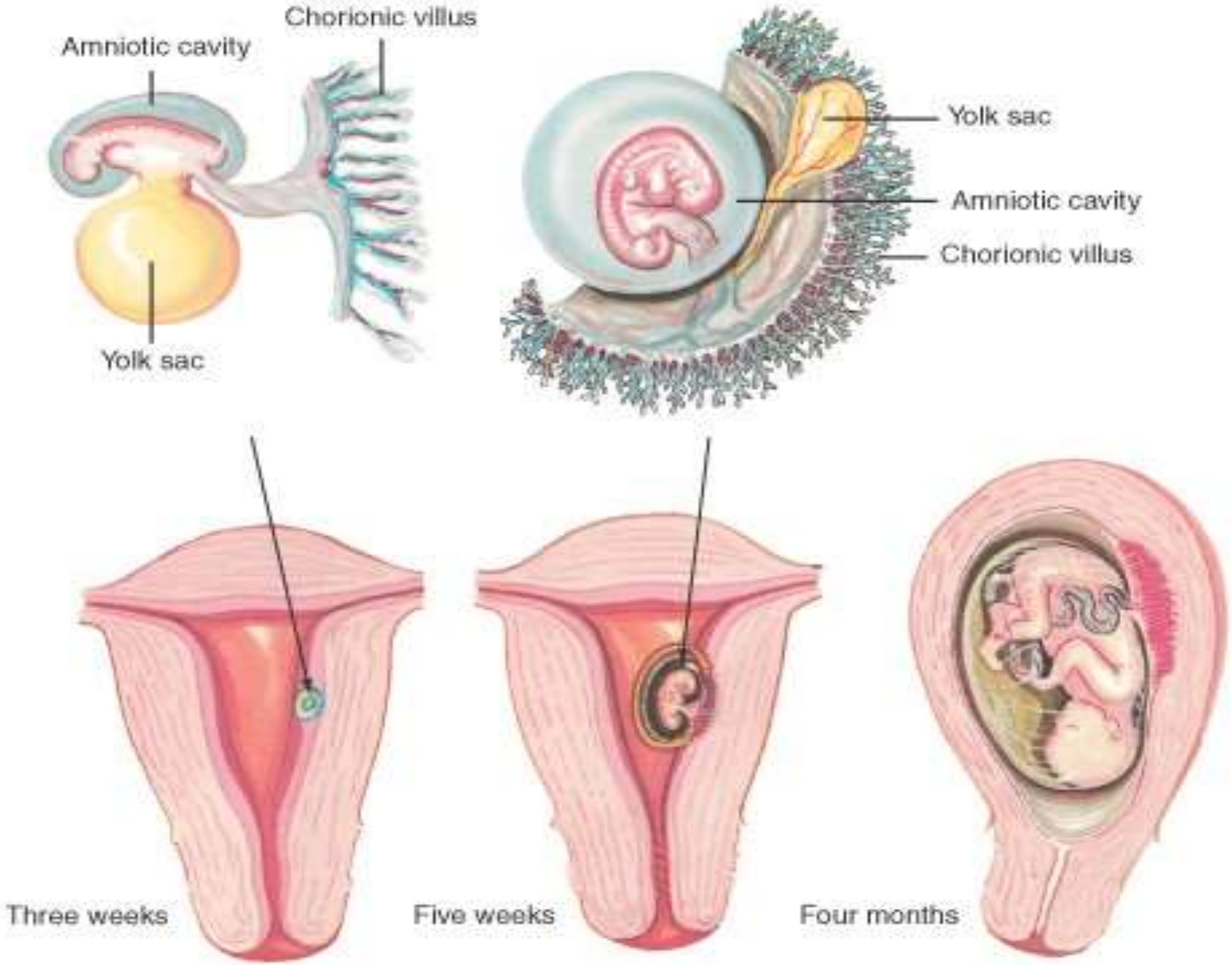


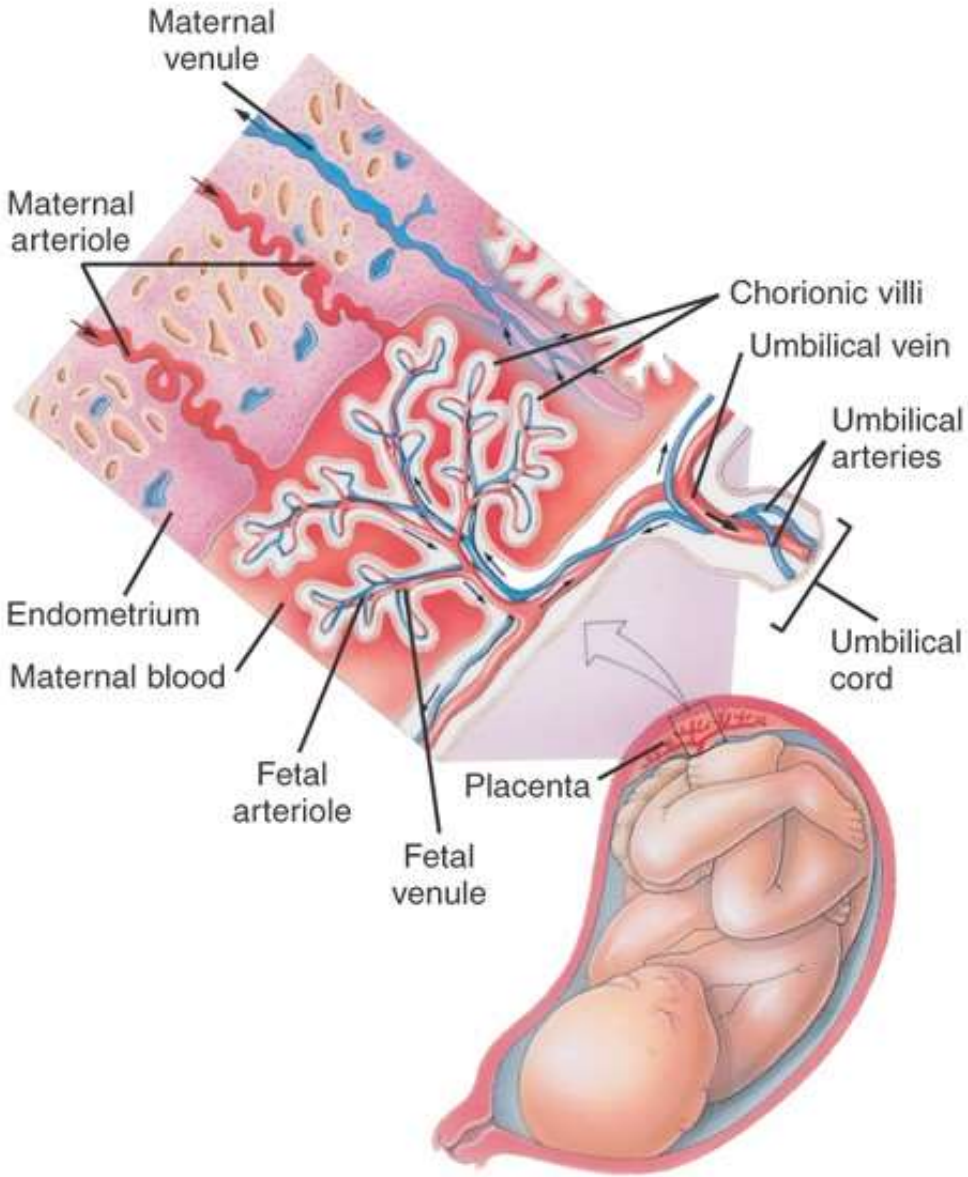
- fertilization membrane forms around the fertilized egg to prevent any further sperm from entering
- usually occurs in the fallopian tube
- corpus luteum maintains progesterone levels which maintain the endometrium and allows development of embryonic membranes and placenta
- zygote slowly rolls down fallopian tube to the uterus (takes about 7 days) then embeds in the endometrium (implantation)
- placenta – chorionic villi (finger-like extensions) develop from the chorion membrane of the spherical mass of cells and protrudes into the uterus
  - uterus responds by developing a similar structure

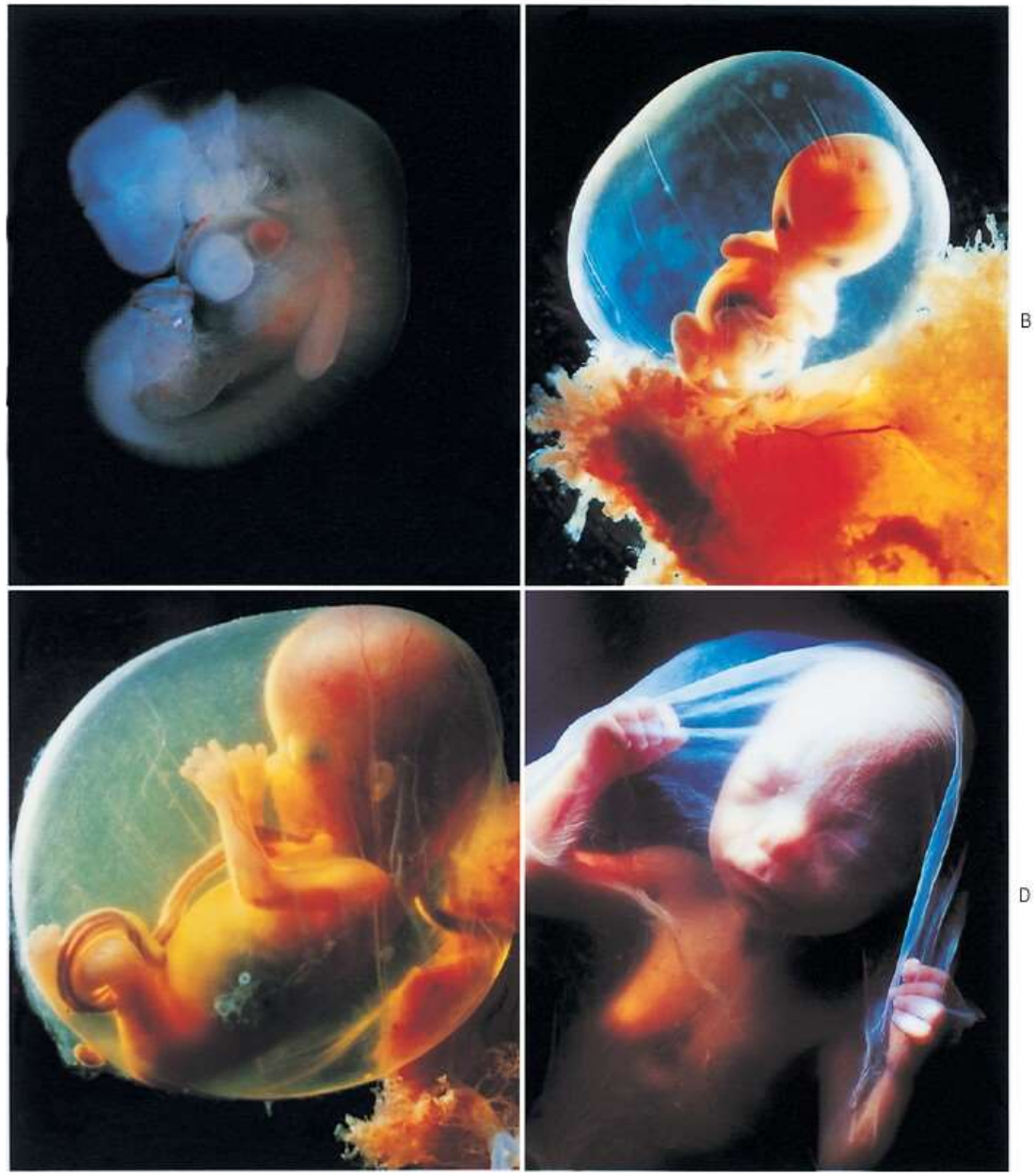
Early development of the placenta



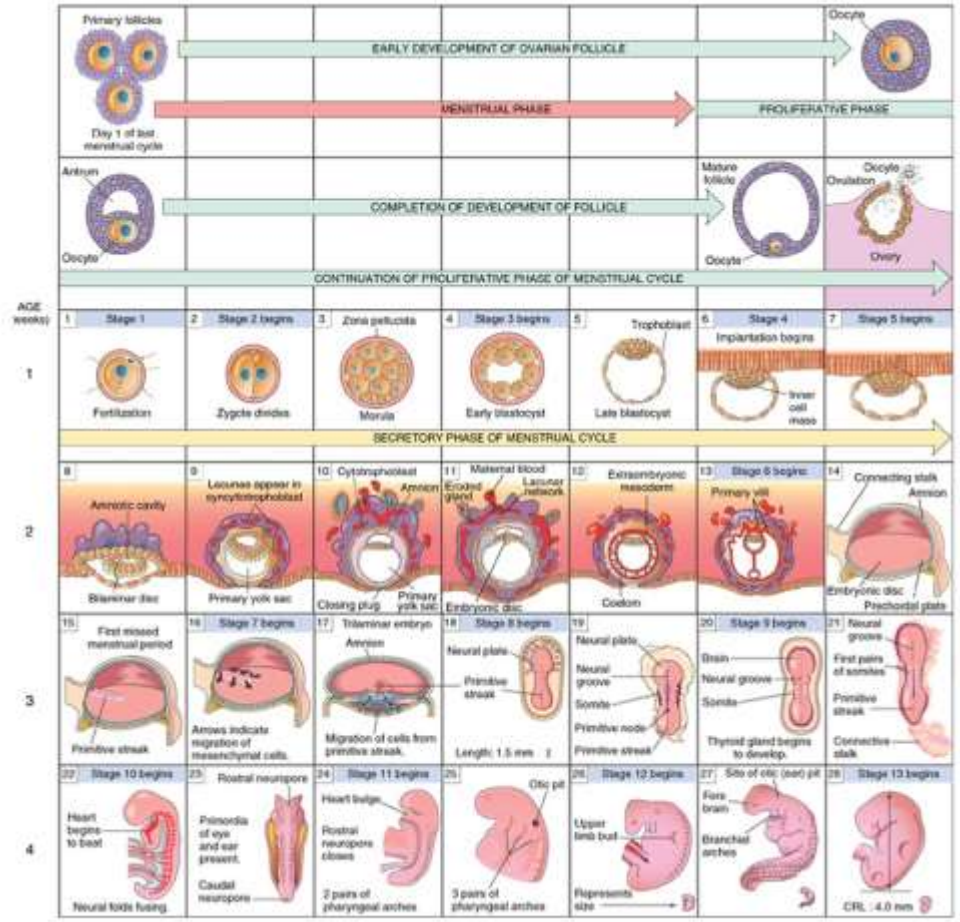
- fetal and maternal blood are in close proximity (no mixing) and nutritive material, gases, hormones, and antibodies are exchanged
- embryo – term used when germinal layers are fully formed (around one week after fertilization)
- fetus – term used when human form is observed (at about 8 weeks)

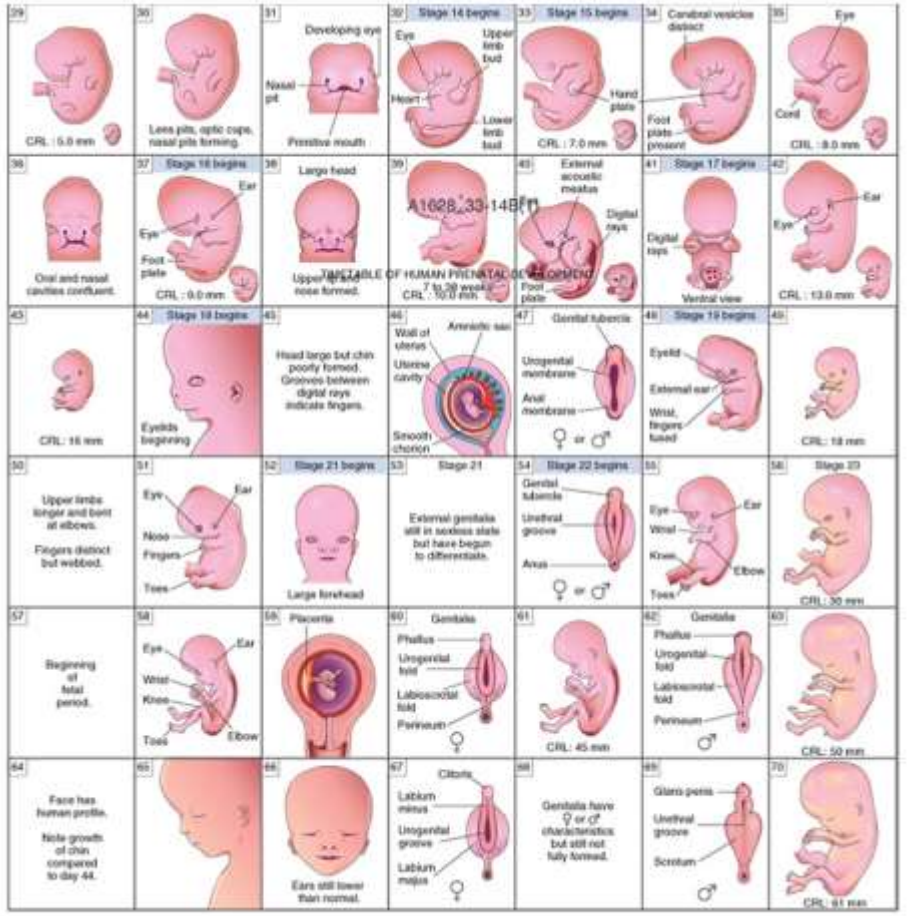


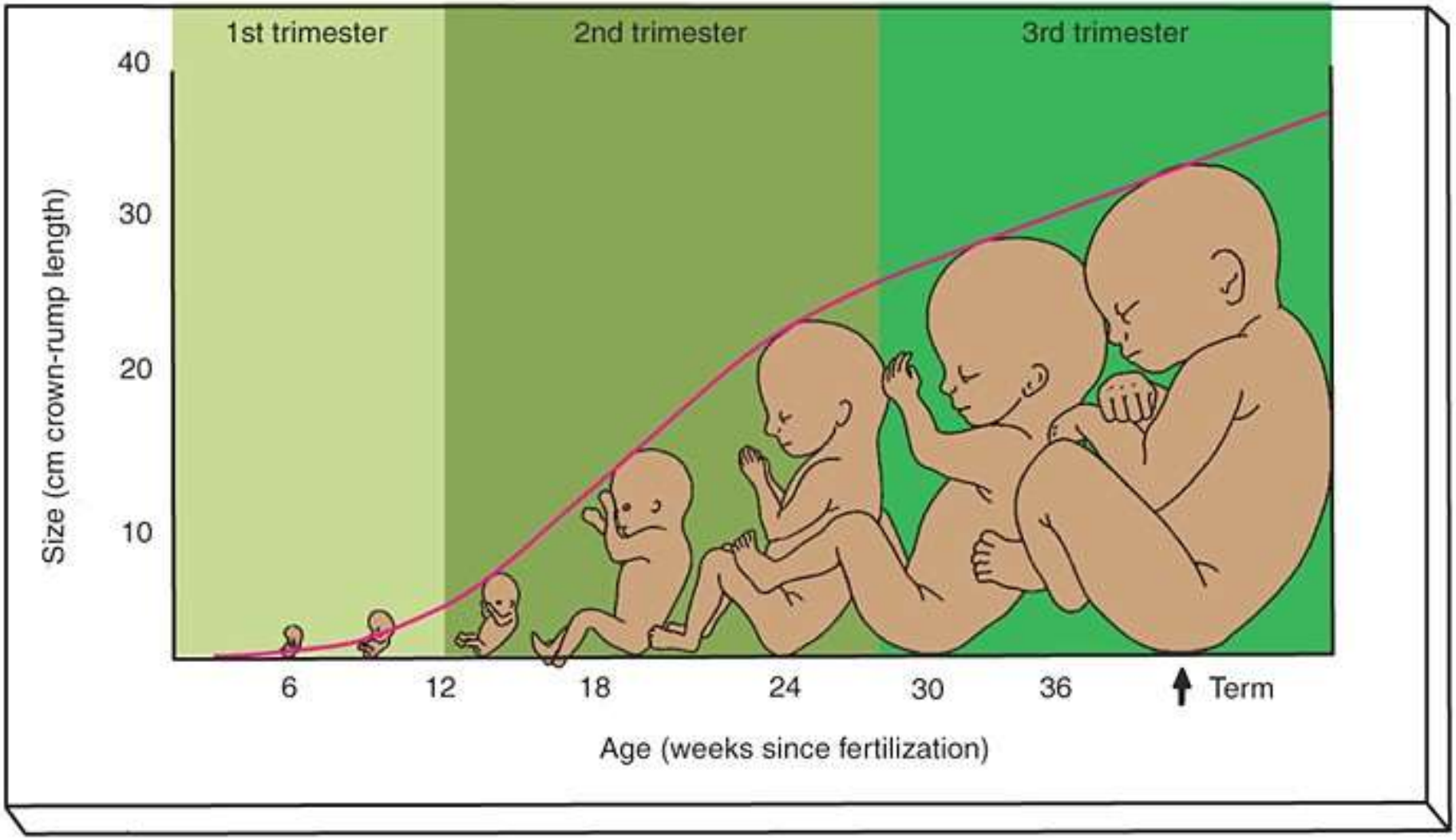


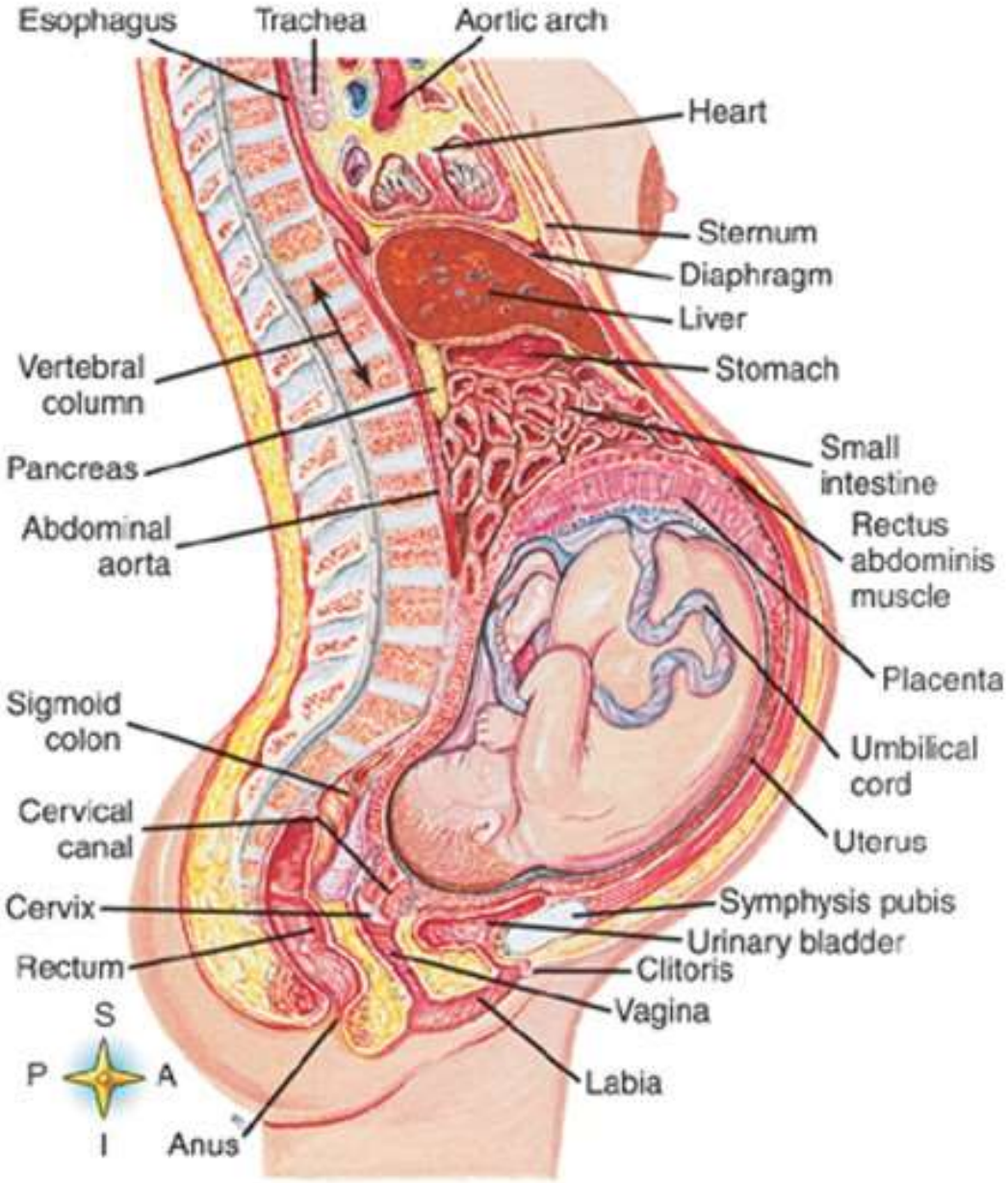


Timing of development humans.







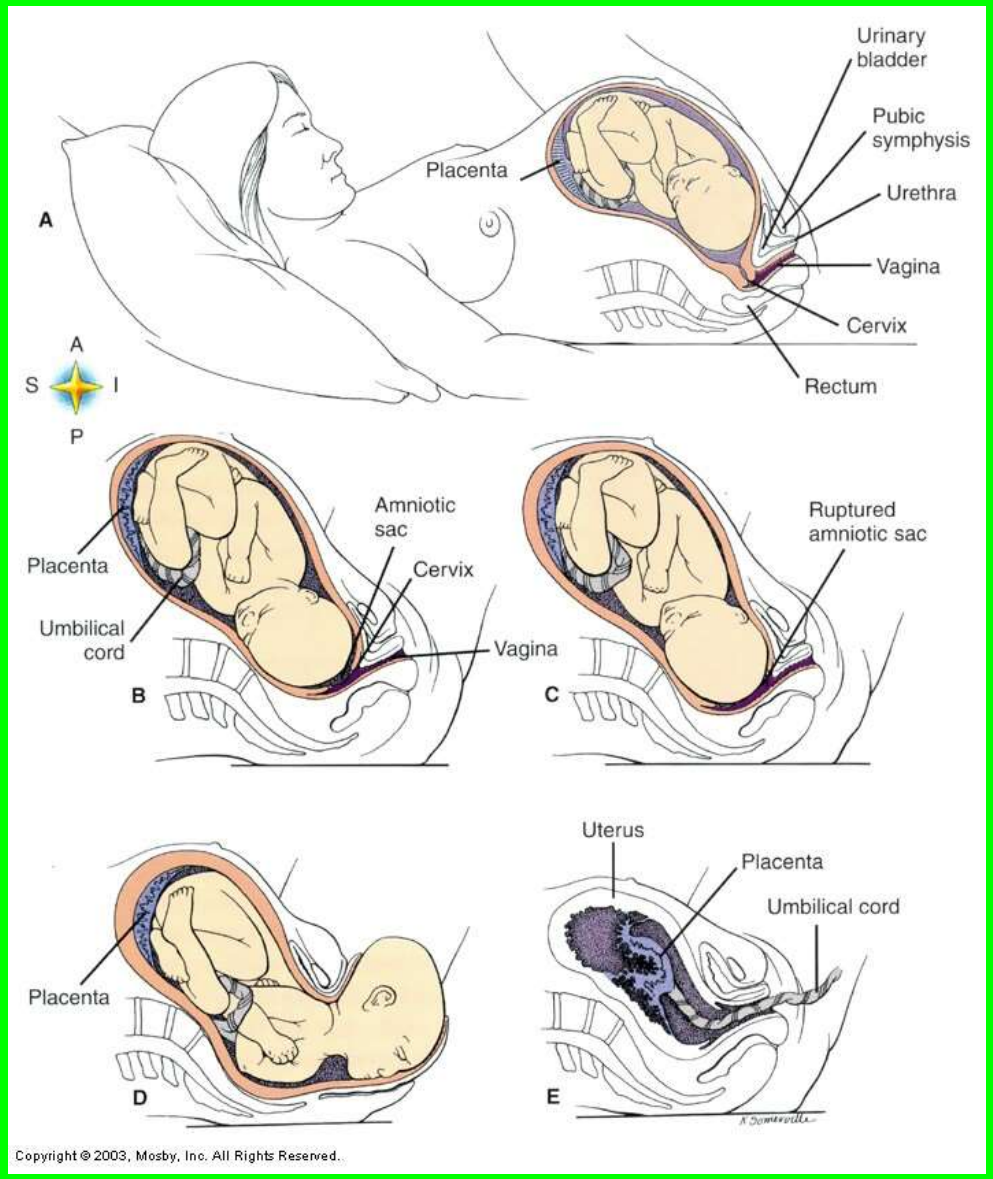


Birth – Labor

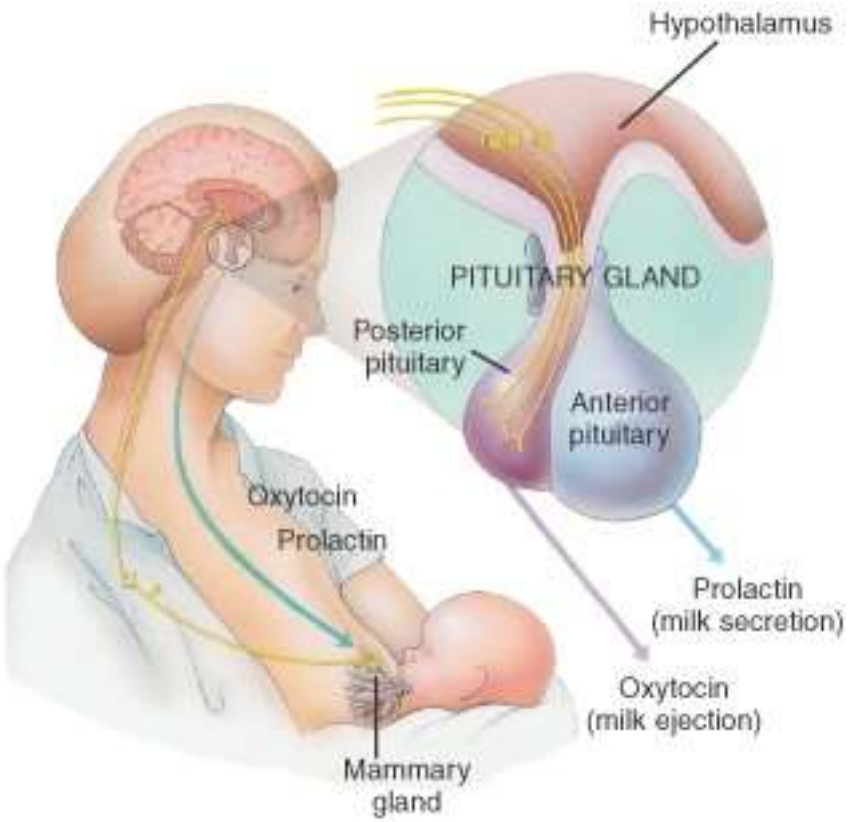
- calculated due date is 280 days from last menstrual period
- fetus produces oxytocin and placenta releases prostaglandins which stimulate contractions of uterine muscles
- Divided into three phases:
  1. Dilation phase – from onset of labor until cervix is totally dilated (10 cm. in diameter)
     - water normally breaks (amniotic sac ruptures)
     - longest stage
  2. Expulsion phase – from full dilation to birth
     - uterine contractions strengthen and last longer

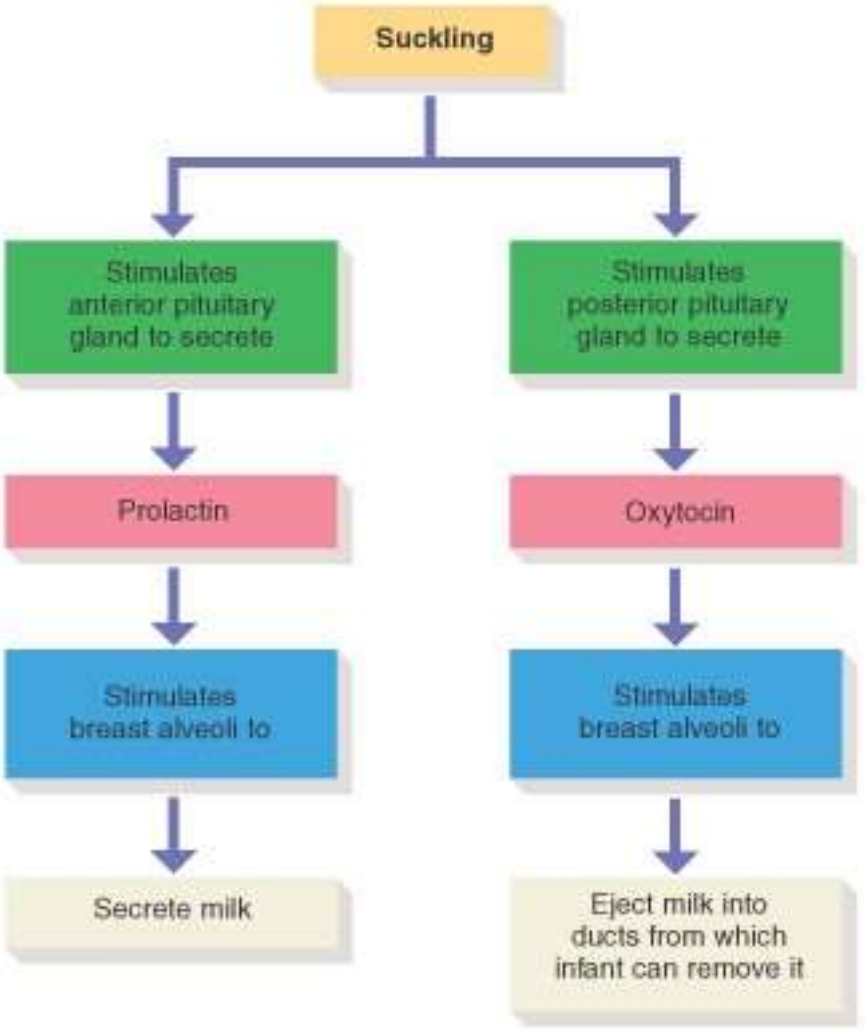
3. Placental phase – delivery of the placenta

- usually within 15 minutes of birth
- afterbirth

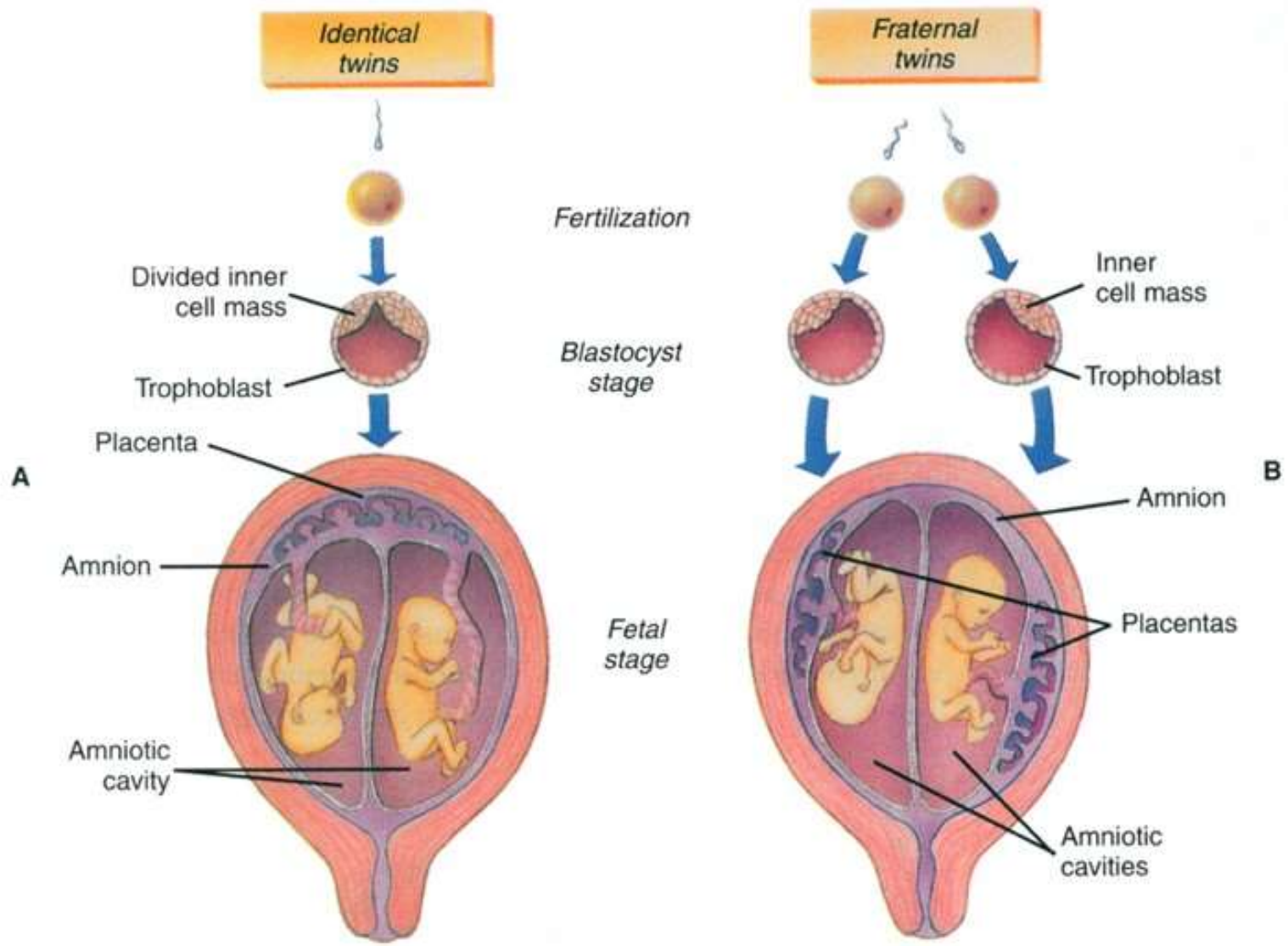


Hormones involved in milk production and release.





Identical vs. Fraternal Twins



Diseases and disorders of Reproductive System

1. Prostatic hypertrophy
   - enlargement of the prostate gland
   - makes urination difficult
2. Ovarian cysts
   - common within or on ovary
   - can become cancerous
3. Inguinal hernia
   - protrusion of part of the intestine into the scrotum or through a separation in the abdominal muscles in the groin region
4. Dysmenorrhea
   - painful menstruation

5. Sexually transmitted diseases (STD's)

A) Gonorrhea

- infectious inflammatory condition involving the mucous membranes of the reproductive organs

- caused by bacteria *Neisseria gonorrheae*

B) Syphilis

- caused by bacteria *Trepoema pallidum*

- chronic disease with symptoms involving lesions, developing into a hard chancre, skin manifestations, and then degeneration of structures like bone, blood vessel walls, or the brain.

- untreated can affect the central nervous system leading to loss of control over voluntary muscles

C) Human Immunodeficiency Virus (HIV)

- causative agent of AIDS
- attacks the T-lymphocytes of the immune system which weakens the immune system and leaves the person vulnerable to opportunistic diseases
- transmitted by exchange of body fluids – esp. blood
- first discovered in homosexual men and hemophiliacs
- now spreading fastest in heterosexual 20-somethings
- no cure although expensive drugs can postpone the onset of AIDS